

Methylviologen-mediated electrochemical synthesis of silver nanoparticles via the reduction of AgCl nanospheres stabilized by cetyltrimethylammonium chloride

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Abstract

© 2017, Pleiades Publishing, Ltd. Efficient synthesis of silver nanoparticles stabilized by cetyltrimethylammonium cations (Ag@CTA⁺) is carried out in aqueous medium by methylviologen-mediated electroreduction of silver chloride nanospheres stabilized by surface-active CTA⁺ cations (AgCl@CTA⁺, diameter ~330 nm), on a glassy carbon electrode at potentials of the MV²⁺/MV^{•+} redox couple. The nanospheres AgCl@CTA⁺ can be reduced immediately on the electrode at a low rate and the resulting metal is deposited on the electrode. In the mediated reduction, the metal is not deposited on the cathode but the quantitative reduction of AgCl to Ag@CTA⁺ nanoparticles proceeds completely in solution volume at the theoretical charge. In aqueous solution, the nanoparticles are positively charged (electrokinetic (zeta) potential is +74.6 mV), their characteristic absorption maximum is at 423 nm and the average hydrodynamic diameter is 77 nm. Isolated Ag@CTACl nanoparticles have the size of 39 ± 15 nm. The preferential form of metal nanoparticles is sphere with the diameter of 34 ± 24 nm; nanorods are also obtained in small amounts (4%); the average size of metal grains is 8–16 nm.

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Keywords

cetyltrimethylammonium chloride, electrosynthesis, mediator, methylviologen, nanoparticles, nanorod, nanosphere, reduction, silver, silver chloride, stabilizer

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